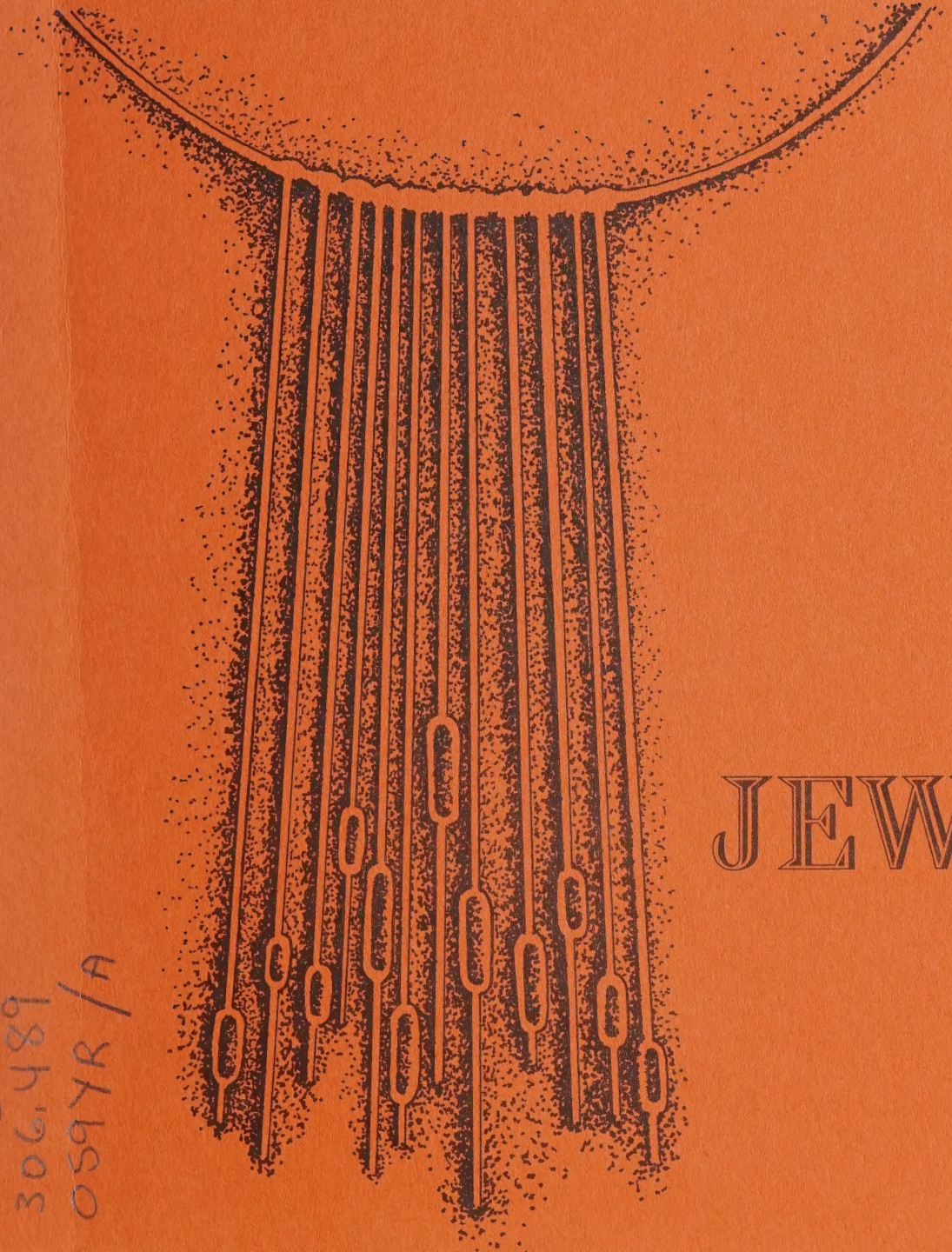


JEWELLERY

PREFACE

The descriptions and the advice contained in this manual are intended to help instructors in jewellery making to guide their beginning students to the level where they can begin to carry out their own ideas. Through these first experineces in the workshop the student will develop his own personal techniques and discover new uses for the traditional materials of the craft.

Although many interpret their ideas by working directly in metal, it is important to learn to develop designs through sketches. By making a drawing and working over it on tracing paper, the design can be developed and refined before committing it to metal.

Sketches also aid in estimating the exact amount of material required and help eliminate the waste of expensive metal. Of course one need not use gold or silver. There is much pleasure to be derived from creating in copper and brass.

Jewellery making is a craft easily carried out on a simple workbench with a few tools. As skill develops and designs become more complex, specialized tools can be purchased. Good tools last longer and are much more satisfying to use than cheap ones.

Students should be reminded that it takes time and care to finish a piece so that it reaches its full potential as an object of beauty. Even the best design can be ruined by poor craftsmanship.

The material for this booklet

has been prepared by

Reeva Perkins

for Youth and Recreation Branch

Ministry of Community and Social Services

Contents

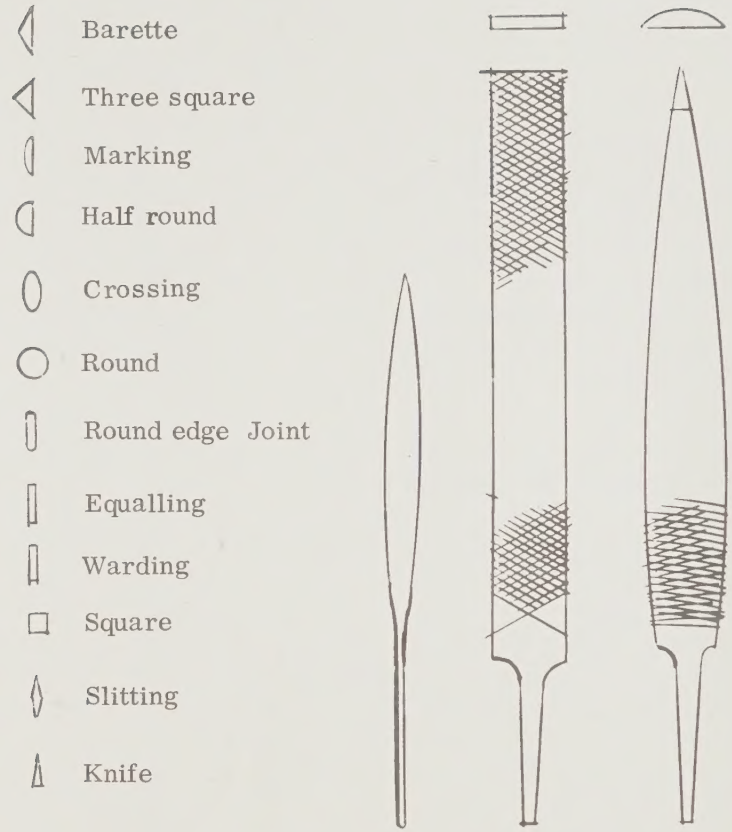


Fig. 2

Set of needle files contains variety of shapes as above:

Tools and Materials

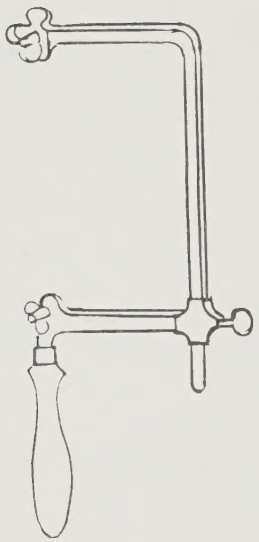


Fig. 1 Adjustable saw frame

CUTTING AND SMOOTHING

4-inch adjustable saw frame. Frames come in variety of depths from $2\frac{1}{2}$ to 8 inches. The 4 inch is the most versatile. Rigid enough for beginner to use easily, deep enough in the throat to take most widths of metal. See Fig. 1.

#2/0 and #3/0 blades to start. The finer the blade the narrower it is in width and depth

Beeswax. To lubricate saw blades as described under sawing

Universal shears. For rough cutting and trimming

Needle files #2 cut. For smoothing

Jewellers shears. For cutting solder

6-inch hand file, #2 cut. Flat file with parallel edges

6-inch half round file, #2 cut

8-inch hand file, #0 cut. For coarse work

Needle file, #4 cut. For polishing in hard-to-reach small openings

File card. Small metal brush for cleaning the metal particles that clog files. It is brushed across the file in the direction of the cut

DRILLING

Hand drill — plus variety of high speed bits

Centre punch. Length of hardened steel with sharp point at one end for marking and making point to start drilling. Automatic centre punch has spring in barrel. No hammer needed. Marks when spring released. See Fig. 3.

Fig. 3. Centre punch

HOLDING AND SHAPING

Bench vise — 3-inch smooth jaw. Should be fastened to work bench or table

Pin vise. For holding small articles such as pin stems. See Fig. 4.

Bench pin. Hardwood, sloping side used when filing; flat side when sawing. See Fig. 5.

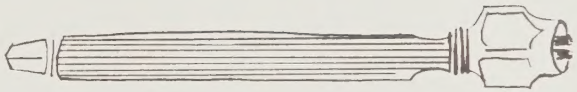


Fig. 4. Hand pin vice

V board and clamp. Hardwood, fastened to workbench with clamp. For sawing and supporting work while filing. Can be used instead of bench pin. See Fig. 6.

Pliers. Smooth jaw, 5" length. See Fig. 7.

Pliers. Flat nose for shaping and bending metal

Pliers. Round nose for shaping curves

Pliers. Half round. Have one half round jaw and one flat jaw, for shaping ring shanks and large, heavy curves

Ring clamp. Wooden clamp with leather jaws. For holding rings and small pieces of metal for sawing, filing or polishing. See Fig. 8.

Ring mandrel. Tapered steel rod marked in ring sizes. For shaping or sizing rings. For shaping articles smaller than rings a nail set or centre-punch may be used

Bezel mandrel. Tapered steel rod in various shapes. For shaping bezels

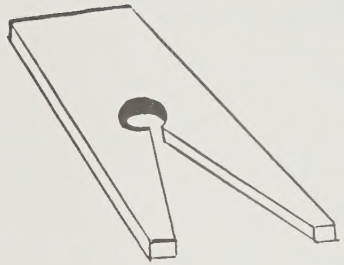


Fig. 6. V-board

Fig. 8. Ring clamp

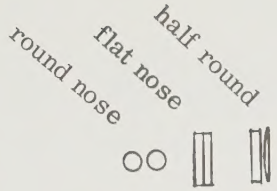


Fig. 7. Pliers

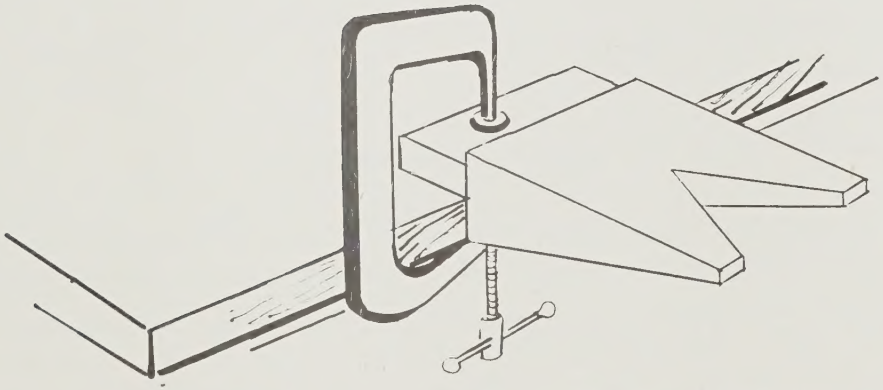


Fig. 5. Bench pin

HAMMERING

Ball peen hammer, 4 ounce. For hardening, stretching, or flattening metal. One end nearly flat, the other ball-shaped. Ball end can be used for texturing. See Fig. 9.

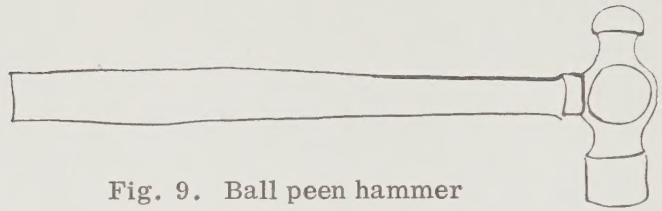


Fig. 9. Ball peen hammer

Planishing hammer. One end flat, one slightly rounded. For forging and smoothing. See Fig. 10.

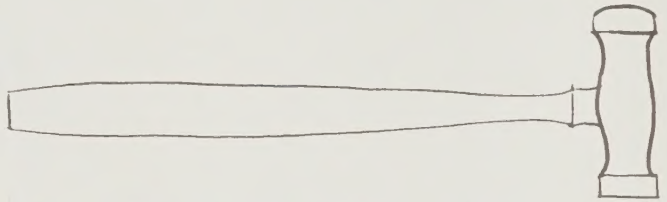


Fig. 10. Planishing hammer

Chasing hammer. Unpolished head can be used with small punches and chasing tools. Small round end is used for texturing and rivetting. See Fig. 11.

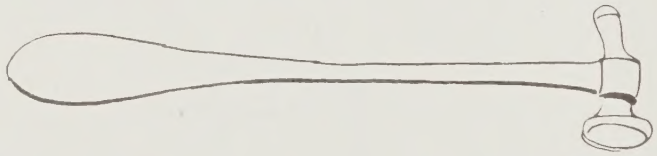


Fig. 11. Chasing hammer

Rawhide mallet. To bend or hammer metal with minimum of stretching or scratching. See Fig. 12.

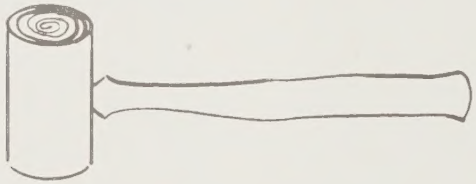


Fig. 12. Rawhide mallet

Fig. 13. Wooden mallet

Wooden mallet. For shaping metal without damaging. Has one rounded end and one either flat or pointed. Fig. 13.

Steel plate. Flat block with polished surface used when flat, hard surface required. Various sizes, but must be at least 1 inch thick. An old flatiron plate is useful

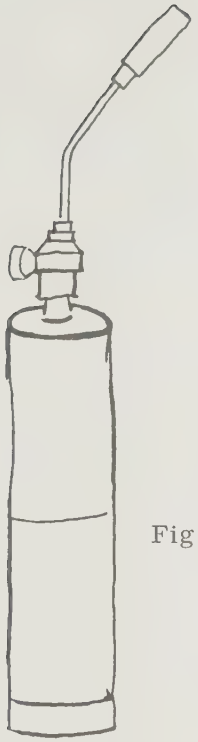
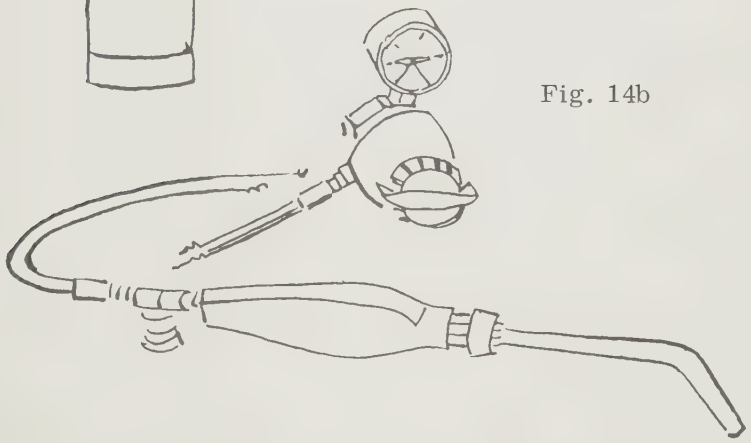


Fig. 14a

Fig. 14b



HEATING AND SOLDERING

Blowtorch. Small pressurized propane gas with reusable, adjustable flametip for small-scale work. See Fig. 14a.

Blowtorch. Air-gas (either propane or natural gas), variety of flame tips for larger work or for a group working together. See Fig. 14b.

Charcoal block or asbestos coil

Pumice pan. Revolving pan filled with pumice, used in annealing

Tongs. Brass or copper for immersing or removing work from acid bath

Tweezers. Inexpensive, fine pointed. For picking up and placing solder

Tweezers. Locking type for picking or holding hot metal

Pointer made from a piece of wire coat hanger filed to a point at one end. For moving pieces of solder which jump out of place when heat is applied

Iron binding wire. Soft iron or annealed wire used to hold pieces together while being soldered. One spool each of 14, 16, 18, 22 gauge

Acid pickle prepared from dry granulated compound containing sodium bisulphate is safer for beginners to use and store than sulphuric acid solution

Flux (borax powder and water) aids in the joining of metals. There are several commercial brands

Flux brush. Small, pointed paint brush to use in applying flux

Solder. Silver, primarily for soldering metal to be enamelled or where a joint of great strength is needed. Melting point 1460°; Hard, 1425°; Medium, 1390°; Easy, 1325°.
delicate work where strength is not needed - 1200°. Gold solders are usually made in the same color as the gold, but about 4 karats lower in purity to reduce the melting point

Scraper. Triangular tool with three sharpened edges. For cleaning areas to be soldered. See Fig. 15.

MEASURING AND MARKING

Chinese white or casein paint. For transferring designs to metal

Scriber. Sharp pointed steel for drawing lines on metal. Can be made from a dental tool ground to a point on a stone

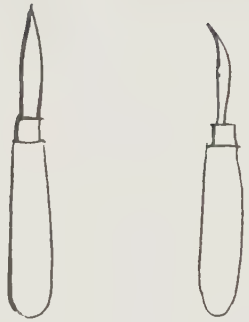
Steel rule. 6-inch length marked in inches and millimeters

POLISHING

Buffing sticks. Smooth, flat sticks with leather glued rough side out to part of one side

Burnisher. Curved or straight tool of highly polished hard steel. For smoothing and polishing hard-to-reach areas. For setting stones in bezels. See Fig. 16.

Emery paper #2 for removing scratches, #2/0 for finishing. See Fig. 17.



straight burnisher

curved burnisher

Fig. 16

scraper

Fig. 15

Rouge - red. For final polishing

Tripoli. Rottenstone mixed with grease and formed into bars. Used on buff to remove fire scale, stains and surface scratches

Buffing machine. A (secondhand) motor 1/4 to 1/3 hp with r.p.m. of about 1725 should be satisfactory. Add spindle to hold polishing buffs and set it up to rotate towards you. A hood to carry off dust and lint, is helpful. See Fig. 18.

Fig. 17 emery cloth stick

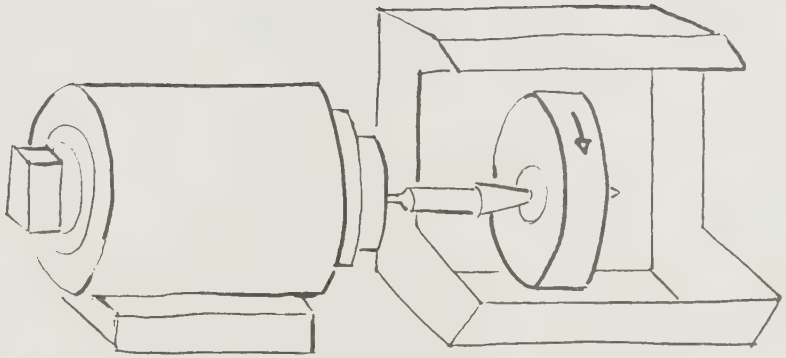


Fig. 18 motor polisher and buffer

TRANSFERRING A DESIGN TO METAL

It's a good idea to make several preliminary sketches before you start actually working in the metal. You can decide which is most aesthetically pleasing, which will wear best and where findings should be placed to work properly and not interfere with the design. Sketches help you estimate the amount of material you will need and may help you avoid construction problems. Sketches may be simple line drawings or finished renderings suitable for submitting to a client for approval.

There are several ways to transfer a design to metal. One is to clean the metal thoroughly with emery paper, or ammonia and water. Cover the area needed for the design with a coat of white casein or Chinese white and let it dry. Then with a soft lead pencil, black the back of the sketch, or use a piece of pencil carbon paper under it and trace the design on the whitened area of the metal.

Another method is to cut out the design and stick it on the metal with mucilage or white glue. Leave it on while cutting.

SAWING

Practise various cuts on scrap metal. Accuracy saves a lot of filing and finishing when completing a piece of work. Saw blades vary from # 8/0 — very fine, to # 14 — very coarse. For general use # 2/0 or # 3/0 are good, but you will have to decide the size best suited to the job.

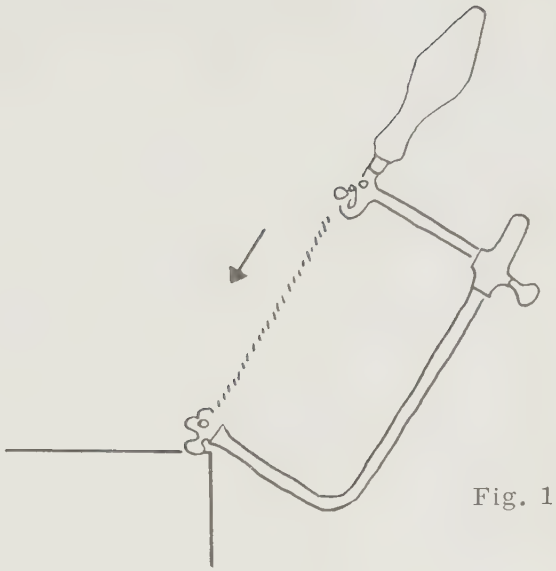


Fig. 19

Blades are made of fine tool steel and are strong but brittle. It is difficult to see the direction of the teeth in fine blades but if you run your finger lightly over the cutting edge, you can tell. Blades must be inserted in the frame with teeth pointing down toward the handle.

To insert the blade, loosen the screws in the clamps at each end of the saw frame. Insert one end of the blade in the frame between the jaws and tighten one of the screws. See Fig. 19.

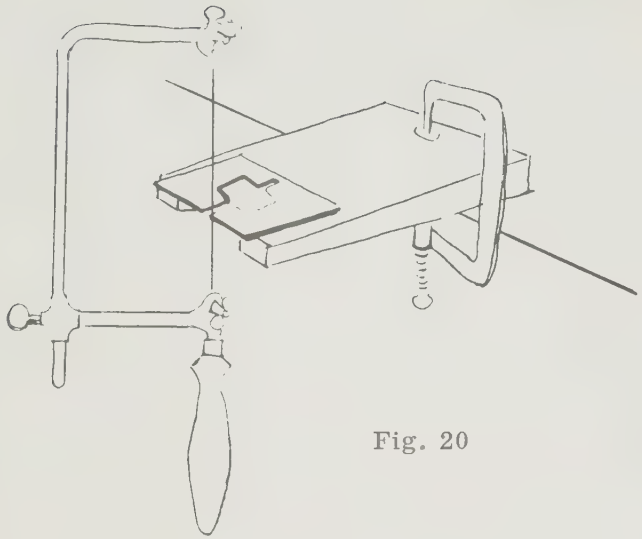


Fig. 20

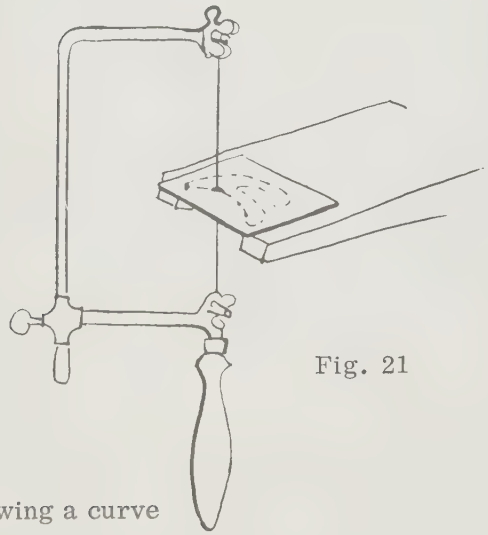


Fig. 21

position for sawing a curve

Brace the top end of the frame against the workbench and press it against your body so that it is slightly compressed. Insert the other end of the blade between the jaws at the other end of the frame and tighten the screw. Release pressure slowly so as not to snap the blade which should be firm and produce a musical note when plucked. If the blade is slack it will not cut accurately and may break. See Fig. 19.

If you have a bench pin, it should be attached to the work bench, flat side up for sawing as shown in Fig. 20.

To saw, hold the frame vertical. To do this you must sit in a lower position than usual so that your work is about six to eight inches below eye level. Hold the handle easily. The saw blade cuts on the down stroke, let saw ride lightly up into position for the next cut. Take your time and take it easy. Too much pressure will break the blade. See Fig. 20.

If you wish to remove the blade at any point in the cut, loosen the top wing nut on the frame, ease out the blade and pull the saw down gently, through the metal. Reset the blade for further work. You can also back the saw out of the work without unsetting it if you move the blade lightly up and down as you back it out.

To make an angle turn, work to the point of the turn then saw up and down in the same place without using any forward motion. This widens the space where the blade is and makes it possible to turn the work slowly to the new angle and proceed with the sawing.

To saw a curve, rotate the work slowly while cutting. See Fig. 21.

If you are sawing a great deal at one time or cutting through heavy metal, lubricate the blade by making a small cut with the bottom few teeth in a piece of beeswax. Sawing action will spread it along the rest of the blade. Be sparing with the beeswax or it will clog the teeth.

PIERCING

To cut out a hole or shape in the central area of a piece of metal, place it on a flat steel bench block and make a dent with the centre punch within the area to be cut out.

Place the work on a wooden surface and drill a small hole through the dent.

Release the saw blade from the top of the saw frame. Thread it up through the hole, fasten and tighten it again in the frame and proceed to saw. See Fig. 21.

When sawing is completed, loosen blade and ease it down through the metal. Remove the cut out metal. Reset saw blade.

Broken blades can sometimes be used by adjusting the opening on the saw frame. A blade that has snapped once has become even more brittle and will easily break the second time.

FILING

Basically, files are used to refine or correct a saw cut and to bevel, round or intensify curves or smooth planes. Choose a file shape that closely follows the line you wish to achieve. If much filing is needed, start with a coarse file and work to a finer one.

Files are designed to cut on the forward stroke only. File from the tip to the handle. Lift the file and return it to position for the next stroke or let it slide back lightly. Do not exert pressure on the return stroke.

Time and metal can be wasted by incorrect filing so it is important to choose the right file and use it properly.

If the work is small, it can be held in a ring clamp or a small hand vise. Larger pieces can be held in the hand and braced against the slanted edge of the bench pin.

To file several surfaces at once, hold in a hand or bench vise. Put a piece of leather between the work and the jaws of the vise to protect it.

To file the straight edge of a strip or sheet, choose a large file so it won't slip. Lay file against the edge of the metal to find the flat surface, then press forward for the full stroke of the file.

To file a concave curve, use a half round file. To file a convex, use a flat. Use a long, diagonal sliding stroke to even out roughnesses and high spots.

To refine small openings, use a needle file. These come in a variety of shapes.

ANNEALING

As non-ferrous metals are hammered, bent or drawn, the molecular structure is distorted and the metal becomes very hard. They will no longer stretch or bend

and there is danger of cracking if they are forced further.

To reduce the stress and restore the normal inner structure, silver, gold and other non-ferrous metals should be annealed by heating to a dull red. Covering with a thin coat of flux before heating will prevent firestain to a certain degree. After annealing, use pickle (acid bath) to clean the metal. It is then ready for reworking.

Annealing should be done with a soft flame over the whole surface. The metal should not be heated past a dull red; it might be damaged or excessive firestain formed. It is easier to judge the colour of the work if annealing is done in a subdued light.

To anneal wire, roll it into a firm coil. Wrap with iron binding wire. This prevents uneven heating and the strands separating. Remove binding wire before pickling.

HARD SOLDERING

Soldering is the process of uniting two pieces of metal with an alloy of the same material but with a lower melting point.

Silver solders come in various grades according to their melting points:

1460° F for soldering metal that is to be enamelled and fired in a kiln, and for joints that will be subject to strain.

1425° F (hard) for first or second solderings.

1390° F (medium) for first or second solderings.

1325° F (easy) for last soldering operations.

1200° F a commercial solder for delicate work where strength is not needed. Also for repair work where gemstones cannot be removed.

Gold solders are usually karat golds of the same colour as the metal you are using except that the alloy content has been increased sufficiently to lower the melting point.

With brass and copper, silver solder can be used. The soldering line will show because of the difference in colour. There are solders which are closer in colour but they are not as versatile.

BASIC STEPS TO HARD SOLDERING

Fitting

Surfaces and edges must fit perfectly along their entire length and breadth. Solder will not fill gaps. A butt joint is stronger if both ends are slightly bevelled to give a larger surface for soldering. Flat surfaces must be free of warps and dents. Remove them by hammering with a wooden mallet on a flat surface.

Cleaning

Solder will not flow on a dirty surface. All fingerprints and oxides must be removed by cleaning or

scraping. Use a soft brush dipped in a solution of household ammonia and water, then rinse well in running water. Or place the article in an acid bath for a few minutes. Or polish the surfaces with emery cloth, or use a hollow scraper to clear areas to be soldered. Remember, both the area and the solder must be scrupulously clean for the solder to take.

Fluxing

Oxides form quickly on metal when it is heated. The areas must be kept clean during the soldering process, so flux is used to cover the areas to prevent oxidization. Hard soldering requires a flux of boric acid, borax or a commercial paste of borax that is thinned with water.

Applying solder

Solder usually comes in sheets or strips. As soon as you get it, mark the grade (hard, medium or easy) over the entire surface with a scriber. If you are not sure of leftover snips of solder, discard them rather than take a chance on a soldering failure.

Cut a small strip from the sheet with jeweler's shears and fringe one end. Now make a cut at right angles to the fringe, placing a finger along the fringed edge to prevent bits from scattering during cutting.

Vary the size of the pieces or paillons according to the work on hand. It is best to use small, slim pieces that will fit close to the seam.

Where more than one operation is to be carried out, solders with successively lower melting points are used.

Solder is transferred to be the area to be soldered on the tip of the flux brush. Dip the brush in flux. Remove excess by brushing against the edge of the bottle. Solder bits will adhere to the tip of the wet brush.

Place the solder in a position so that any residue can be removed after pickling. Try to put the work together so joints and seams will not be noticeable. Figs.23, 24, 25.

Heating

Place the piece to be soldered on a charcoal block, asbestos coil or pumice pan, depending on the size of the work.

Rotate the flame around the outside of the piece to dry the flux. If heated too rapidly, the flux will boil and displace the solder. Keep a pointer in your hand to reposition any solder that moves. The pointer also prevents burnt fingers in case you forget and touch the hot metal.

Once the flux has formed a white crust, the work may be heated directly. Be sure to keep the flame moving while bringing the work up to soldering temperature.

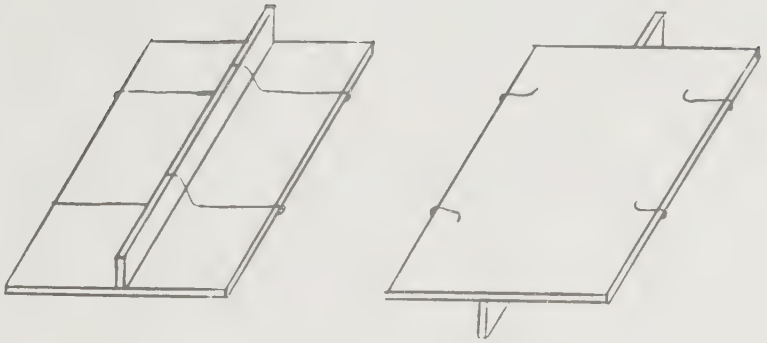
If heat is concentrated on one spot, the metal may melt. All portions to be soldered must reach the flow temperature at the same time. If you are soldering delicate wire to a solid background, heat the background only or the wire will burn before the larger piece of metal reaches soldering temperature.

The flow point should be reached fairly rapidly or the flux will lose its protective qualities. When you have almost reached the correct temperature, concentrate

the tip of the flame on the solder area. When the solder melts you will see a fine bright line of silver along the seam.

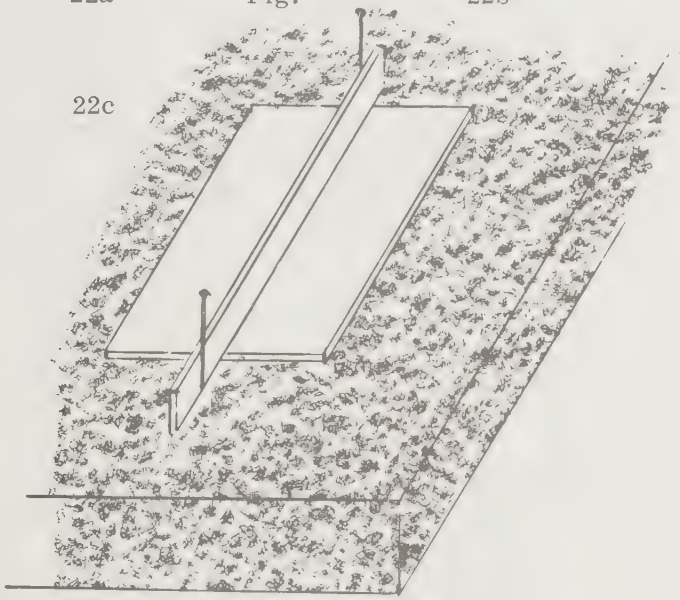
You will be able to judge the correct colour of the metal for soldering only through experimenting. Soldering in a room with subdued light will help you identify the colour of the metal more quickly. As you heat it the colour will change from dull red (annealing temperature) to cherry red. If the solder has not flowed by this time, do not continue. You will damage the metal. Allow metal to cool. Place in the acid bath to clean and prepare again for resoldering.

Setups for Soldering



22a Fig. 22b

22c



put binding wire over top and hook under edge kink wire with flat nose pliers to tighten; this leaves room for expansion during soldering

or

steel pins or right angle binding wire pins inserted in charcoal block will hold work in position

More Setups for Soldering

Fig. 24a on round wire file end with half round needle file to contour for snug fit

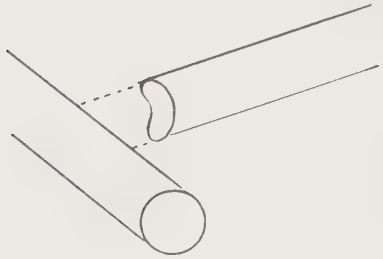


Fig. 24b rotate flame over both bars for even heating—final flame position for soldering

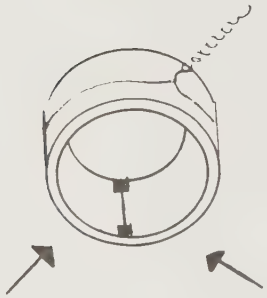


Fig. 25 ring held by binding wire, paillons in position

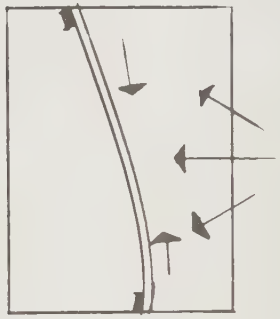


Fig. 23 give solid surface greatest heat move flame from ends to centre to draw solder under and along length of wire

Reasons solder may not flow:

. dirt or grease on the seam faces or area

. solder forming a ball from excessive preheating

. breakdown of flux from excessive heating

. parts not forming a perfect seam or join

. wrong grade of solder

Sweat soldering

To join two flat surfaces of any size together, flux the underside of the top plate. Flux solder and position as illustrated in Fig. 26. Be careful to place paillons as close to the end of any projections as possible. If projections are narrow, place solder down the middle only. Heat the work with a circular motion until the solder just begins to flow. Remove flame, leaving small mounds of solder.

Clean in acid solution, neutralize and dry.

Flatten the mounds of solder slightly by filing with 6-inch file. See Fig. 26. Flux work and place both pieces together. Since they are both flat, gravity should keep them in position. If you prefer they can be held with iron binding wire.

To have an even heat for both top and bottom pieces, the work can be placed on a flat nest of binding wire, or on horizontal, parallel nails on charcoal block or asbestos coil. This permits the heat to pass underneath.

Do not use a brick because it dissipates heat and prevents rapid heating to soldering temperature. It is a good idea to leave the lower piece slightly larger than the upper to ensure an exact fit. File away the excess when the join is perfect.

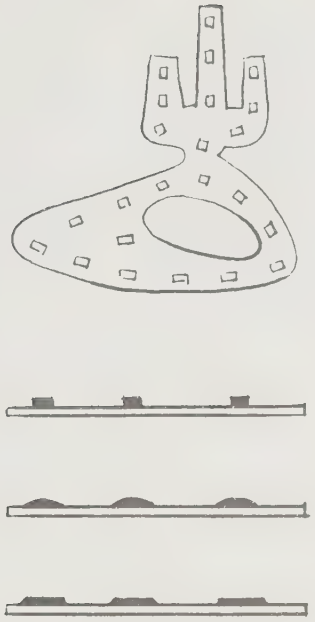


Fig. 26 solder before heating
solder slightly flowed
solder flattended by filing

Pickling

Hard solder fluxes contain borax. This forms a glass-like coat under high heat and prevents oxides from forming during soldering. This coat must be removed before further soldering or finishing. Let the work cool. Remove binding wire before immersing work in acid because if pickle touches iron, it will discolour silver with a deposit that is hard to remove.

There are commercially prepared powders containing sodium bisulphate that are safer to use and store than sulphuric acid pickling bath. Follow the directions carefully.

Always add acid slowly to water. Never water to acid.

If solution is splashed on skin, wash immediately with soap and running water. Rinse thoroughly. Keep solution in a lead pan, covered porcelain crock or heavy glass container with heavy glass cover.

Always use brass or copper tongs for immersing or removing work.

Rinse acid from work thoroughly.

Do not inhale fumes.

Keep acid covered and in safe place when not in use.

Pickle solution works faster if heated. To heat, place acid in a fireproof glass dish in a metal pan of water and heat on electric plate.

If you have work made up of more than one layer, or with hollow components, the acid may seep in and corrode. Neutralize by boiling work in a cup of water to which has been added a heaping tablespoon of sodium bicarbonate.

Pickle or acid bath for gold, silver, copper, brass or bronze can be made of 1 part sulphuric acid to 10 parts cold water. Be very careful if you prepare this solution in place of the commercial pickle.

SOFT SOLDERING

When it is not possible to use high heat, a lead solder with melting point under 1000° F. is used. The method is quite different from silver and gold soldering.

Solid core lead solder and the flux of muriatic acid and glycerine are available in hardware stores.

To solder ear-ring backs: scrape the spot and touch with acid-glycerine flux. Repeat for cup.

Hold the ear-ring back in soldering tongs. Put a small piece of lead solder in the cup and melt with a small, soft flame. Cool. Place in position on the ear-ring and apply just enough heat for solder to show at the edge of cup. Avoid high heat. It will cause lead solder to pit the silver and anneal the temper of the ear-ring back. After the solder has hardened, scrub with soap and hot water or boil in sodium bicarbonate solution. Do not pickle in acid. Remove excess solder with a scraper or scotch stone.

Cuff link backs

The ear-ring procedure can be used for one-piece backs where high heat would anneal the spring.

Combination pinbacks

Copper or nickel combination pinbacks to be used on copper or enamelled jewellery should be scraped and fluxed as for ear-rings.

Set the pinback in place with the pintong open to the right. Put a small piece of soft solder in the opening in centre of pinback and heat brooch just enough to melt solder and make it run under the pinback. Keep flame away from pintong. Scrub with soap and hot water.

FUSING

Sometimes it is desirable to combine metals by heat without solder. Designs may be created by adding precut pieces of wire, or beads. Silver filings may be fused for an granular effect. Filings or cuttings of different metals with a higher melting point than the base metal may be used. Try it. Experiment.

First clean and flux metal to prevent oxidization. Apply heat to all parts to be fused until you see indications that the surface is melting. Too much heat will cause metal to collapse. It takes practice to judge the moment of fusion. While random combinations of scraps may produce some happy accidents, better designs and useful techniques usually result from the careful planning of experiments and projects.

Fusing a bead on wire

Hold the wire in tweezers with the fluxed end down. Direct a hot flame on the end only. See Fig. 27 The wire will begin to draw up into a bead. Withdraw the heat if you wish to retain the bead on the wire, otherwise it will drop off when it reaches a certain size. Beads can also be made by placing small pieces of fluxed silver or gold on a small, round hollow in the charcoal block and melting with the torch. Withdraw flame slowly.

Textures

Place sterling silver on an asbestos block or on a pan of carborundum grains. Use a very hot flame to melt

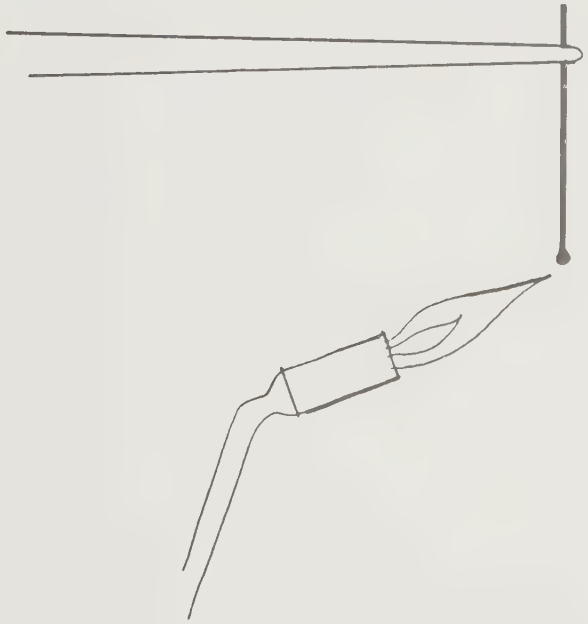


Fig. 27 hold wire in tweezers fluxed end down, direct flame on end only

just the surface of the sheet while retaining the shape of the form.

As soon as the surface begins to wrinkle, remove flame. If the texture isn't right, it may be heated again. The first texture will be oxidized. If it does not retain the colour throughout the completion of your work, it can be reoxidized with liver of sulphur. Polish highlights.

FINISHING

If the piece of jewellery is very complex, it is best to finish each part as much as possible before assembling. Sometimes scratches can't be removed once the pieces are soldered together. Take care with this stage. A fine work can be spoiled by sloppy finishing.

Emery paper removes scratches. It comes in grades from coarse #3 to #0 and #2/0 to #4/0 very fine.

Grade no. 2 for rough finishing and #2/0 and #3/0 for fine polishing is a good assortment. Always wrap emery paper around a stick. Scratches and indentations are accentuated if emery paper is used in the hand.

Emery Sticks

To make an emery stick take a smooth stick about 1 inch wide, 12 long and 1/4 inch thick. Lay the edge of the paper along the narrow edge. Scribe a fold line on the inside of the paper where it comes to the edge of the stick. Continue around the stick, scribing at each edge. Go round several times. End at the narrow edge. Cut. Staple or tack along the edge to hold. As each layer of the paper wears out, it can be cut off at the stapled edge.

For more intricate work, smaller pieces of emery paper can be wrapped around a needle file, orange stick, dowel or popsicle stick. Worn emery paper should be kept and used when a fine grade is needed.

To Polish Very Small Openings

Attach one or more pieces of soft string, or nylon, to workbench. Run rouge or tripoli over it several times. Thread the loose end through the opening in the metal, pull string tight and run the jewellery back and forth with pressure. This is called thrumming.

Work across scratches to remove them. Work from coarse emery down to fine, until the piece is perfectly smooth. Buffing and polishing will never remove file marks.

Hand Polishing Sticks

Hand buffs can be made up in various sizes. Take a flat, smooth stick about an inch wide, 1/4 inch thick and 12 inches long. Trim a strip of leather 1 inch wide and glue rough side out to the wide sides of the stick.

Tripoli

Tripoli is a cutting compound made of siliceous earth called rottenstone combined with tallow and pressed into bars. When rubbed on the leather of the polishing stick, it removes firestain formed during soldering. Take care

not to rub too long in one direction or grooves will be cut in the work.

Firestain

When gold or silver is heated above annealing temperature, the base metal of the alloy separates on the surface and forms a film or shadow called firestain. It tarnishes rapidly and will show up on the work. It must be removed before a high polish can be obtained. To see if firestain is completely removed, shield the work from direct light by placing hand against the edge of the metal.

Boracic Acid and Alcohol

Gold alloys can be protected from firestain by holding the work in a pair of tongs and dipping it in a solution of boracic acid and alcohol then igniting it with the torch. It will burn off with a green flame, leaving a protective coat. Use as much boracic acid as the required quantity of alcohol will absorb. Pickling in acid (after fluxing and soldering) will remove the protective coat as well as the flux, so the bath of boracic acid and alcohol and the burning off will have to be repeated for each soldering.

Final Polishing

After all traces of firestain have been removed, wash all traces of tripoli from the work with either a soft toothbrush and soap and water, or a mild solution of household ammonia and water.

Rouge is used for the final polish, red for high polish; white for mirror finish.

Separate buffs must be used for each cutting or polishing compound.

Hand Polishing Chain or Wire

Place a round, wooden rod upright in the vise. Loop chain or wire around the rod, holding ends in your hand. Stretch it towards you and rub with a soft piece of folded leather impregnated with polishing compound. Wash and dry.

MACHINE POLISHING

Machine polishing saves time. No need to buy a new motor. A secondhand 1/4 to 1/3 hp with an r.p.m. of about 1725 should be satisfactory. Add a spindle to hold your polishing buffs and set it up to rotate towards you. A hood to carry off dust and lint, is helpful.

Buffs

Buffs can be bought as needed. To start, two 2-inch and two 4-inch muslin or flannel buffs should do.

Brush Buffs

This type is handy for irregular surfaces or creviced pieces.

Ring Buffs

Ring buffs are tapered cones of wood covered with felt, used for polishing the inside surfaces of rings.

Felt Buffs

These come in different shapes. Should be used with care or they will form grooves in the metal very quickly.

To Condition New Buffs

Place each one on the spindle. Apply a small amount of

the buffing compound to be used with the particular buff as it rotates. Loose lint will either fly off or protrude. Turn off the motor and burn off the ends of protruding fibres one small area at a time. Extinguish each section quickly before continuing. Once the loose fibres have been removed, the buff is ready for use.

During Polishing

Apply compound lightly but frequently. If possible, hold the work in both hands with thumbs covering the edge toward you to prevent the piece from being pulled from your grasp. Position as shown in Fig. 28 so the piece is touching the buff below the centre horizontal line. Then if you lose your grip, the piece will be thrown down on the work surface rather than at you. Keep moving the piece back and forth so the buff touches it in several directions. This prevents grooves from appearing.

To Polish Chain or Wire

Wrap it firmly around a board and hold the loose ends in your hands so that it cannot catch in and twist around the buff. For safety, polish a little at a time. The motor rotates at high speed and if the chain or wire catches, it could wind around the spindle and harm you and the chain.

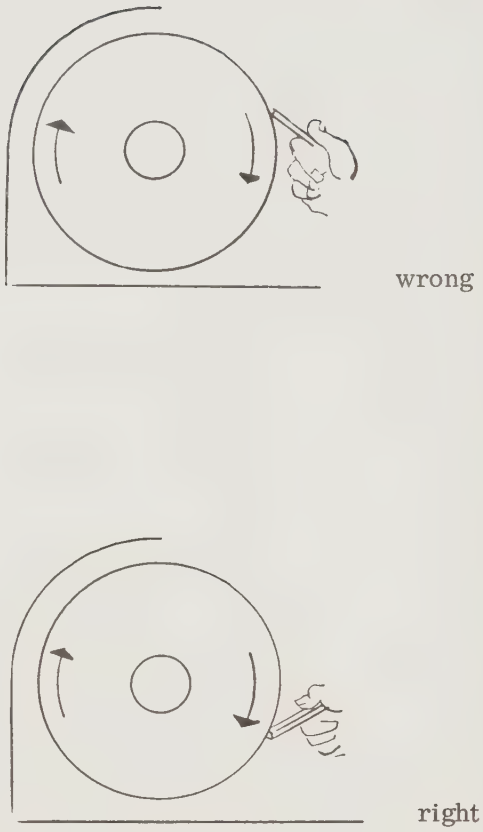


Fig. 28

FINISHES

The methods just described give a high polish. A soft lustre can be achieved with pumice powder or a scratch brush finish.

Pumice Powder

Remove all traces of firestain. Dip your thumb in water then in finest pumice powder and rub over the surface of the metal. Repeat until the desired lustre is reached.

Scratch Brush Finish

Bring work to a high polish. Anneal and allow to cool. Pickle in hot sulphuric acid solution or commercial pickle. Rinse. Brush lightly in one direction with a soft brass scratch brush and liberal quantities of soap and water. This process must be repeated three times to bring up a scratch brush finish. The annealing and pickling dissolves the oxides on the surface and leaves a layer of pure silver.

Oxidizing

The simplest way to oxidize silver, copper and bronze is to use liver of sulphur (potassium sulphide) dissolved in water.

First wash the metal with a toothbrush dipped in a solution of ammonia and water to remove all grease. Rinse well. Dissolve a small lump of liver of sulphur in a cup of water. Action can be hastened by heating the solution in a porcelain or fireproof glass dish. Do not use a metal container.

Either apply the solution with a brush, or dip the work in it until the desired colour is reached. Rinse in water and dry. Wash both the brush and your hands immediately.

Too thick a coating of oxide will flake. If this happens, remove it all by heating and pickling, and repeat the process.

It is best to make up liver of sulphur solution as needed because it deteriorates quickly. Potassium sulphide should be stored in brown air-tight bottles and kept in a dark cupboard.

To highlight areas where colour is not wanted, rub with wet pumice powder on a cloth or the fingers. Rinse. Polish the highlights with rouge.

Ringmaking

The choice of metal for the ring band is based on the ring's intended use. A ring for continuous wear such as a wedding band, should be at least 14 gauge gold or silver for a woman and 12 gauge for a man. If, however, the band is to be part of a complex structure it can be lighter. The width should be determined with comfort in mind.

Ring shapes vary. There is no rule that says a shank must be round. Fingers are not perfectly round and will conform to almost any ring shape. The shank can be open or closed, round, square, oval or tapered and may be made from any form of wire or constructed from sheet.

Ring Band

1. To find ring size, take a strip of paper about three inches long and the width you have chosen for the shank. Wrap it around the large knuckle of finger. Mark paper at overlapping point. Add twice the thickness of the metal to be used. The width should be determined with care: wearing too broad a band can cause irritation.
2. Saw the strip of metal as measured and file ends.
3. Anneal the metal before bending.
4. Bend the ends with rawhide mallet over the ring mandrel held in vise or braced against bench pin. See Fig. 29.
5. Remove from mandrel. Hold strip on workbench or anvil and tap gently on one curved end to form a circle, as shown in Fig. 30. It does not have to be a perfect circle at this point, but the ends must be tight and parallel for soldering.

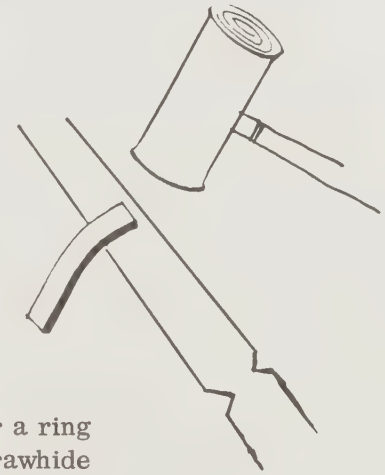


Fig. 29

bend ends over a ring mandril, use rawhide mallet

6. To parallel, hold the shank against bench pin with a flat needle file in the seam. Exert just enough pressure with thumb and forefinger to file edges smooth.

7. To build up tension in the metal, overlap the ends back and forth and over and under each other then snap together to a smooth joint. If it is tight, binding wire is not needed, but it can be bound as shown in Fig. 31. Remove binding wire after soldering and before pickling.

   If you need a higher temperature for a heavy piece of metal, you can increase the value of the torch flame by building a small, three-sided shelter of charcoal blocks or asbestos to prevent dissipation of heat.

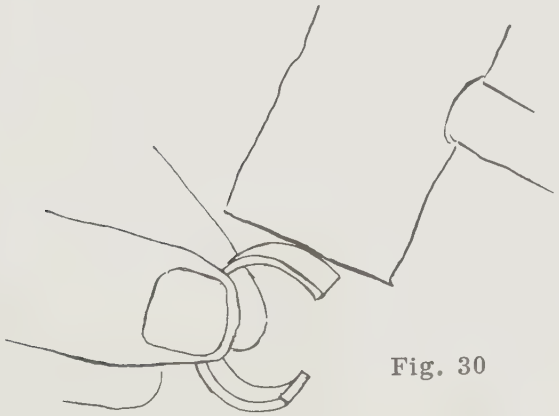


Fig. 30

with rawhide mallet
tap ends together

8. After soldering and pickling, remove excess solder from inside seam with a half round file. True ring to a circle on the mandrel by hammering with rawhide mallet while rotating ring. Because mandrel is tapered , it is necessary to reverse ring during the hammering.

   If ring is slightly too small, it can be stretched by planishing the surface on the mandrel with light, even strokes of the planishing hammer. Reverse ring frequently to keep it true. Anneal if necessary.

   If ring is too large, cut out a section including the solder joint and re-solder.

9. When the ring fits, finish by filing, polishing with emery papers and buffing inside and out.
   Finish and polish each part of a complex design before assembling. It may not be possible to reach some areas after final soldering.

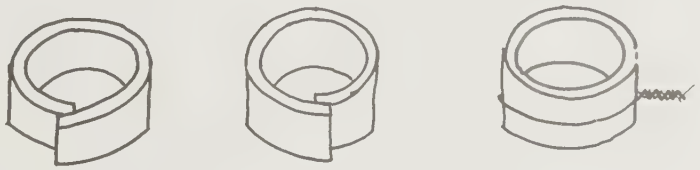


Fig. 31

Bezel for Cabochon

The bezel is a collar of thin metal to fit around the base of a gemstone and hold it in place. Fine silver or gold, 22 to 26 gauge, should be used so that it can be readily burnished around the stone.

1. Determine the depth of metal needed and allow a little extra for finishing. If it is too deep, it will crease when burnished. If it is too shallow, it will not hold the stone securely. See Fig. 32.
2. Find the length of material needed. For circles, the formula is $\frac{22}{7}$ times the diameter of the stone plus the thickness of the metal.

   For ovals: approximately twice the length of the stone plus the width, plus the thickness of the metal.

   Another method is to take a strip of the metal and press it around the base of the stone as shown in Fig. 33. Mark at overlap and cut slightly smaller. If the ends twist in cutting with shears, they can be realigned by pressing between the jaws of flat nose pliers. File ends to fit. Because the metal is soft, it will be difficult to bind with wire but you can build up tension as described under ring bands.
3. Use very small amount of hard solder to join. Solder and pickle.

Fig. 33 determining depth of metal for bezel

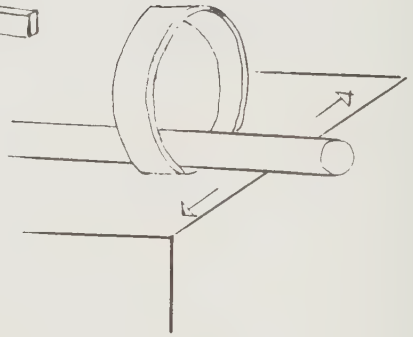


Fig. 34 finding length of metal for bezel

Fig. 32

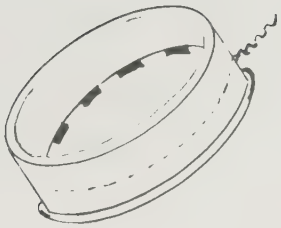


Fig. 35 stretching bezel with small steel rod

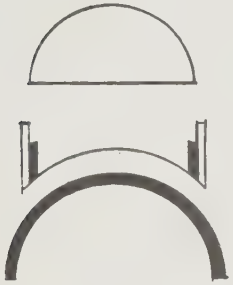


Fig. 36 bezel wired, solder in position

Fig. 37 curved bezel with inner bearing

4. Bring to perfect shape by planishing with rawhide mallet on bezel mandrel or smooth rod. Fit to stone. If it is too small, it may be stretched by inserting smooth steel rod and rolling it back and forth on bench block or hardwood block as in Fig. 34. Or it can be planished very carefully. Test frequently for fit because thin metal stretches easily.

   If too large, cut on each side of the soldered seam and remove the uneeded section. Resolder.

5. File the top and bottom edges of the bezel. Be sure to keep them parallel. Sometimes it is easier to rub the bezel flat on emery paper. Finish with emery stick.

6. Leave backing metal slightly larger than the bezel. Unless the stone is opaque, cut a hole in the backing. It should have the shape of the stone but about 3/4 of its diameter. If the stone is opaque, just drill a small hole in the backing to make it easy to remove the stone if you need to.

7. Wire the bezel carefully. Solder it to the backing, placing solder inside the bezel. Remember the bezel is much lighter than the backing and will heat up faster. See Fig. 35.

Bezel with Bearing

An inner bearing (seat for the gemstone) is necessary in a bezel if the backing is to be curved as in a ring or bracelet, (see Fig. 36) if you wish to raise the stone up, or if the stone is convex on the bottom.

Prepare a bezel as above (steps 1 to 5) but allow extra depth to accommodate the depth of the bearing.

3a. Cut a strip of 18 to 20 gauge metal. It should support the stone and leave enough of the outside bezel above to be burnished around it when setting the stone. It must be snug but not tight enough to have to be forced in to the outside shell.

7a. Hard solder the seam. File.

8a. File top smooth so the stone will fit squarely. File a slight bevel on outside top edge to prevent piling up of excess solder.

9a. Wire outside bezel to lessen chance of seam opening. If you leave inside bezel extending slightly below outside bezel, you can turn the bezel upside down in carborundum grains and place solder on extended ledge. This will help to protect the thin upper wall of the bezel while soldering. The extension can be filed off after. Solder seat into bezel with medium solder, making sure seams are on opposite sides of bezel. See Fig. 37. Pickle.

10a. File bottom of bezel to conform to surface to which it is to be soldered - the curve of the ring or bracelet etc.

11a. Make sure stone sits perfectly in the bezel before soldering bezel to the base. Emery and polish. Bind to base with wire. Reflux and solder to base with easy solder.

In designing the work, make sure the bezel can be reached for setting the stone. Make sure the upper part of the bezel does not touch any other part of the design or it will be impossible to burnish the edge smoothly. Colour and finish the work before setting the stone.

SETTING STONE

Ring can be held in a ring clamp or on a mandrel. Place stone in bezel and make sure it sits square. Brace work against bench pin. Using a highly polished steel pusher, press the bezel against the stone at opposite sides. See Fig. 38. Now very carefully go round and round the bezel with the polished convex surface of the burnisher pressed against the bezel to remove all marks and to make sure the setting is smooth and tight. Fig. 39. Keep a firm control on burnisher. It can slip easily and cause damage.

CLAW SETTINGS

Because light passing through a transparent stone increases the intensity and brilliance, claw settings are often preferred to the closed bezel.

There are many variations and you will likely develop your own to meet your special needs. However, the following examples are given to help solve some of the basic problems in setting conventionally cut stones and irregular shapes.

1. Make a closed bezel with a bearing, as described previously, using 18 gauge sterling silver or 16 if the stone is large. If the stone is faceted or has a convex base, the bearing should be bevelled slightly toward the center with a needle file before being soldered inside the bezel to give the stone a firm seat. Allow enough setting depth for the claws to reach well over the edge of the stone. Fig. 40. Level top and bottom edges with a flat file. Emery the bezel.

2. Mark the centre and width of the desired number of claws on the top edge of bezel. With dividers scribe a line to indicate the depth of the claws on the outside

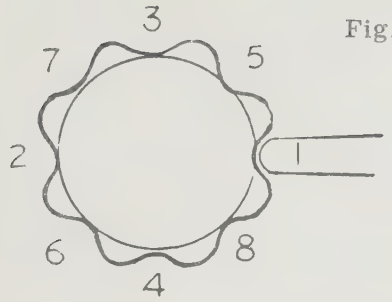


Fig. 38 seal in position ready for soldering

Fig. 39 use pusher to press bezel against stone

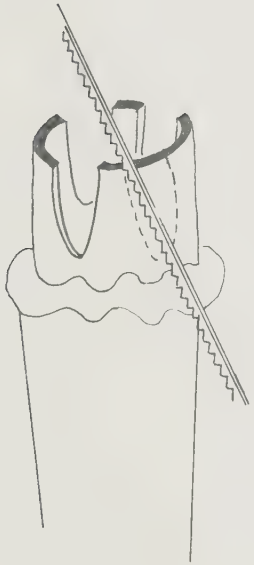


Fig. 41

Fig. 40

of the bezel. To let more light reach the stone, the claws can be cut below the seat of the bezel

3. Mount the tube on a stick in melted sealing wax. Claws can be cut by angling the saw and cutting one at a time, or by filing with a needle file. Keep them even. The size of the space between claws will vary with the shape of the stone. See Fig. 41.

4. Finish edges with emery wrapped around a needle file. Remove from sealing wax and polish. File excess metal from claws after bezel has been soldered in place. When the work is finished and polished, the stone can be set.

5. Claws are bent slightly outward by pressing down between them with a round dapping punch a little larger than the stone, or they can be bent out very gently, with pliers.

6. The piece must be held firm while stone is being set. If it is a ring, place it on a ring mandrel or in a ring clamp. Push the stone in place and hold securely with index finger. Use a stone pusher which has been slightly roughened to prevent slipping and press the claws over the edge of the stone a little at a time, working alternately on opposite sides. After all claws are set, test tightness of stone with fingers. If not firm, continue to work with pusher. Polish claws by rubbing with curved steel burnisher.
If it is impossible to get a claw or closed bezel to press snugly against stone, put the ring on the mandrel in bench vise. Use a small flat end chasing tool and with chasing hammer gently tap against the

claw or bezel. As you move the chasing tool, overlap strokes. In this way, you will move only a small amount of metal at a time and prevent crimping.

In addition to the prong settings available through jewellery supply houses, you will want to construct settings for irregular or asymmetrical stones.

Prong settings can be devised by making a base and soldering prongs of wire or sheet to the outside of the setting. The depth of the base depends on the size of your stone and whether it is an important part of your design.

When you have settled on the depth, solder a band the exact size of the girdle of the stone. Cut prongs longer than required. File small grooves on the outside of band where prongs are to be soldered. Prongs can be wired in place or pushed into a charcoal block to hold them in position for soldering. See Fig. 42. When soldering is completed, file off the excess prong extending beyond bottom of the bezel. See Fig. 43.

If the stone is irregular, the seat for the stone should be filed to conform to the contour of the perimeter of the base of the stone to prevent cracking under pressure when the prongs are being set. The prongs should be an integral part of the design and structurally strong enough to hold the stone firmly. They need not be of equal width, but can reflect the shape of the stone and design of the jewellery.

With experience you will learn the potential and the limitations of metals and devise your own manner of constructing stone settings.

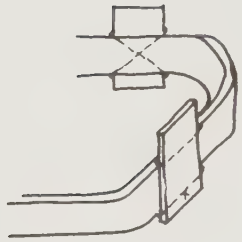


Fig. 42 prongs wired in position ready for soldering

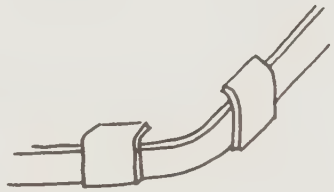


Fig. 43 prongs bent, filed

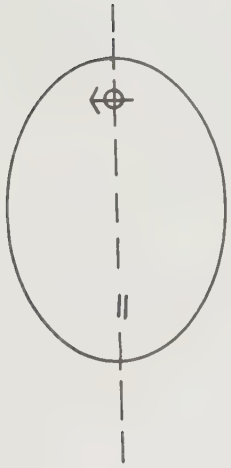


Fig. 44a planning location of catch and joint

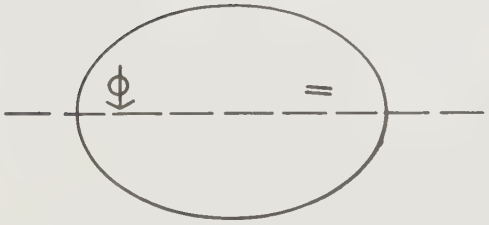


Fig. 44b

There are many good commercial findings on the market. Most suppliers have catalogues which they supply on request.

JOINTS AND CATCHES

Those for soft solder come in one piece with a bar between the catch and hinge to provide a greater surface for solder.

HARD SOLDERING

It is advisable to buy sterling silver for use on sterling. Try to get gold findings of the same karat as your pin because plated catches and joints present problems in soldering.

The joint is usually spread - squeeze parallel with pliers, before soldering. File the bottom of the joint with a small needle file to clean and level. File the bottom of the catch. Scrape small spots on the back of the pin for the hinge and catch.

Location of the catch and joint should be thought out so that when the pintong is riveted in the joint it will line up slightly above the catch for tension. It should be about 1/3 of the depth of the pin from the top when it is to be worn horizontally. See Fig. 44b. If it is further

down, the pin will be inclined to topple forward when worn. Joint and catch should be aligned as shown in Fig. 44a. with the catch facing down so that if it opens by accident, the weight of the pin will keep it from falling off.

A tiny amount of paste made with rouge and coal oil can be inserted in the top of the catch with a toothpick to prevent solder from running into it. Follow the usual soldering procedure but use only a small amount of flux and place small, slim paillons of easy solder on each side of the catch. Never place it in front or back as it will run into the catch.

Catch should be half open when being soldered, with the two little knobs on top.

Heat the work slowly. Do not let the flame touch the catch or joint until the last moment when the solder is ready to run.

SOLDERING KARAT GOLD FINDINGS

Use the same procedures but use gold solder of a lower melting point than used for assembling the pin.

SETTING PINTONG

After pickling and polishing, you are ready to set the pintong. Place a strip of masking tape on each side of the joint while fitting and riveting to prevent scratches.

RIVETING PINTONG

Some pintongs come with the rivet in them. Slight pressure in square nose pliers will remove it. If there isn't a rivet, make one with a piece of nickel silver or sterling wire.

Place the pinstem in position in the joint to check if the stop flange at the bottom needs filing to allow it to swing in to the catch and also to open no further than 90° to the brooch.

You can insert a small piece of wire through the joint and pinstem opening to aid while checking for length and tension.

If necessary, file the flange slightly and refit. It is better to do this several times than remove too much at once.

If the flange is not deep enough to prevent the pinstem from opening too wide, it can be stretched slightly by tapping with a cross pein hammer and refiling to shape. The pinstem should project just slightly beyond the catch, but not beyond the edge of the brooch. It can be shortened by clipping, filing to a point and polished so it will penetrate cloth easily. Hold it in a pin vise to make it easier to file.

A small amount of rivet should project on each side of the hinge. If it is too long, shorten with needle file. With the back of the brooch against the steel block and bracing the under side of the rivet on the surface of the block, place a riveting tool or a nail set over the top of the rivet and tap gently several times with chasing hammer as shown in Fig. 45. Turn brooch over and repeat the operation on the bottom of the rivet. Smooth with emery wrapped around a needle file.

Rivet setting pliers are not necessary. You can make a

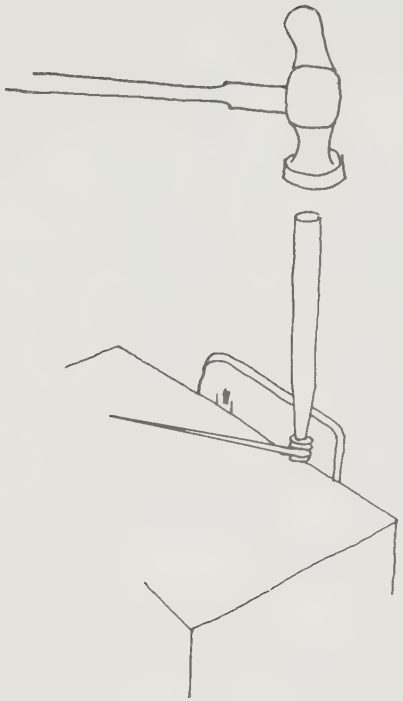


Fig. 45 setting the rivet

Fig. 46a cuff link
back construction

riveting tool from a piece of tool steel about 4 inches long and 1/8 inch square. Round one end to a slight dome and polish with emery.

Never hard solder a joint with pinstem attached. The heat anneals the metal and makes it too soft to be used.

CUFF LINK BACKS

Most commercial cuff link backs have the joint and rivet construction as in Fig. 46A and can be soldered as described under 'joints and catches'.

After riveting, the cuff link should move freely but not wobble.

It is easy to construct your own findings. Use a piece of square, sterling silver wire about 5/8 inches long. Make two arches and attach one to the bar and one to the cuff link. The third link of round wire should be oval and soldered as per directions for chains and filed flat at the bottom. See Fig. 46B. The overall length between cuff link and bar should be 5/8 inch so link is easy to get in and out of cuffs.

EARRING BACKS AND TIE TACKS

Soft solder because hard soldering takes the temper.

JUMP RINGS

These are circles or ovals used to connect units of chains or jewellery. The smaller the ring required, the finer the wire used. Only by trial and error can you arrive at the gauge to use for the effect you wish to create.

Wind wire on a mandrel - this can be a welding rod, the smooth end of a drill bit, a nail with head and point cut off, dowel rod, steel knitting needle, etc. If the wire is too springy, anneal it. To do this, wrap a layer or two of tissue paper around the mandrel in the direction the wire will be wrapped. Insert in the chuck of a hand drill. Set the drill handle in vise so mandrel points up as in Fig. 47. Bend a right angle in the wire about 1/4 inch from the end. Hook it down beside the mandrel between the jaws of the chuck. Squeezing the wire against the mandrel with your left thumb and forefinger, turn the hand drill to wind a spiral of wire. Each ring should be snug against the one below.

Remove mandrel from hand drill. Place it on charcoal block and anneal with torch. The paper will burn away and wire can be slipped off.

Depending on the size of the mandrel, it may be more convenient to hold it with ring clamp or bench vise.

To cut links, brace hand against the bench pin. Hold the spiral firmly between thumb and forefinger. Place saw blade against the spiral at such an angle that only three or four links are cut at a time from top to bottom as shown in Fig. 48.

When cutting oval or rectangular links, saw through the middle of the narrow side. Use a fine saw blade to eliminate need to file joint before soldering.

To close the rings, hold each end in parallel pliers and bend ends past each other, then pull back into alignment. Tension will hold them together for soldering. See Fig. 49.

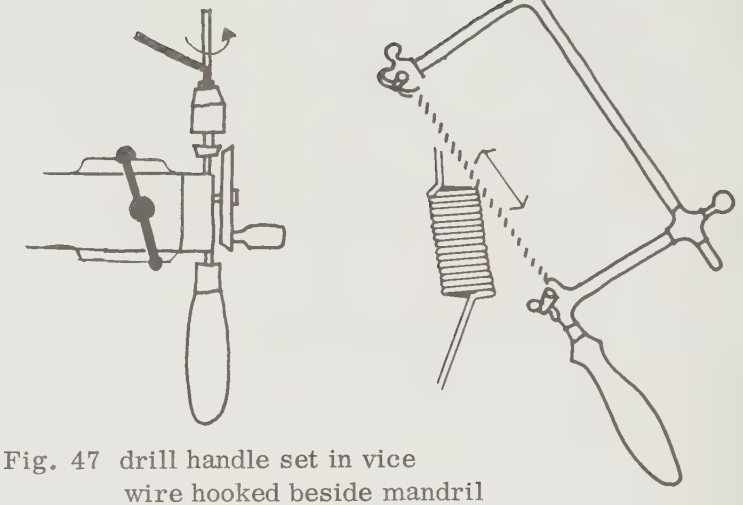


Fig. 47 drill handle set in vice wire hooked beside mandril between chuck saws

Fig. 48 position saw so only 3 or 4 links are cut at a time

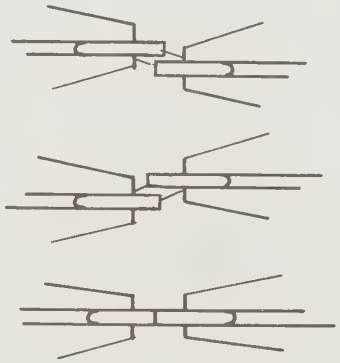


Fig. 49 hold each end in pair of parallel pliers, bend pair each other, then pull back to align

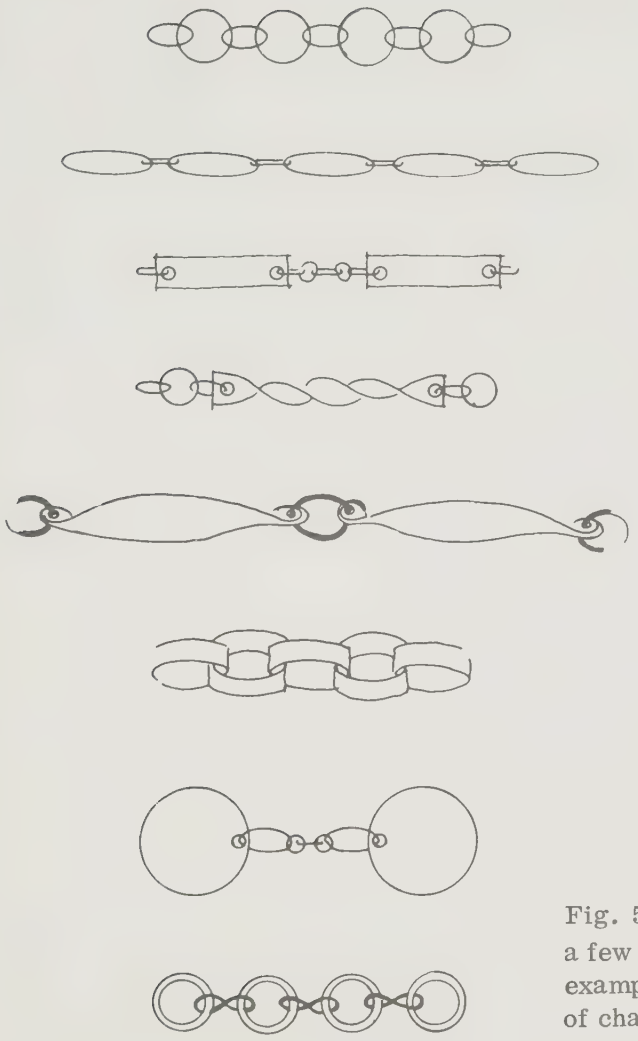


Fig. 51
a few
examples
of chain

SOLDERING-JUMP RINGS

Hold jump ring at lower end with soldering tweezers. Brush the seam with flux. Pick up a very small paillon of solder with flux brush and place directly on top of joint. See Fig. 50. Use a very small flame heat around ring without directly touching the metal to dry the flux and prevent solder from jumping. Now hit the lower end of the seam several times with direct heat. Solder will flow very quickly. Do not keep heat on too long or solder will flow down the ring instead of in the seam.

Fig. 50 jump ring ready for soldering

CHAIN MAKING

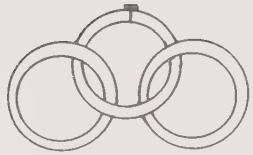
Chain units in wire are made exactly the same way as jump rings. The mandrel dictates the shape of the links.

Estimate the number of links needed by putting a few together without solder. Possibilities are endless. Links can be plain, textured, interlocking, different in shape and size, solid or open. A few samples are illustrated in Fig. 51.

SOLDERING LINKS

Solder the links in groups to save time and effort. Solder about half the number needed by spacing them on charcoal block. Apply flux and tiny paillon to each seam. When they have been soldered, join each two links with a new link, again spacing them on the block. Apply flame only to new link to avoid melting the previous join.

Another method of soldering the new link is to support it on a heavy piece of binding wire as shown in Fig. 52. Anneal and oxidize binding wire first to prevent solder from sticking to it.



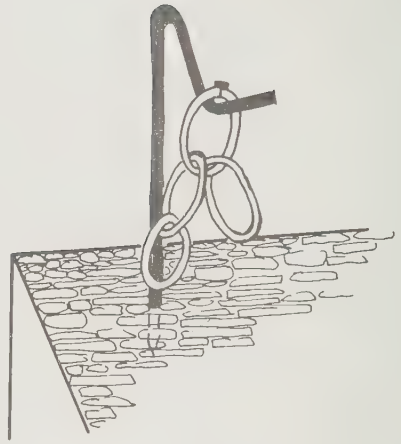


Fig. 52 link for soldering supported on a binding wire hook

Continue joining groups this way until you have the desired length. When chain is complete, pickle and examine carefully for imperfect joins. Remove excess solder and polish.

Hand polishing is recommended because it is dangerous to polish by machine. However, if you must machine buff, be sure to take the following precautions.

Chain must be wrapped firmly around a board with rounded edges. The ends of the chain must be fastened down very securely, or held firmly by the hands, away from the polishing area. Polish chain in small sections. Do not use pressure because it will stretch and distort the chain.

TWISTING WIRE

Much interesting jewellery can be made with twisted wire. Experiment with round, square and flat brass and copper wire in different weights and combinations. You can twist single or several strands at a time. If you anneal a twisted strand, you can combine it with a new strand and twist them together for an entirely new effect. Try round and square together. Twisted wire can be textured or broadened by hammering it on the steel block with ball pein hammer.

When measuring the wire, allow an extra inch or two because twisting reduces the length. Anneal before twisting.

For a double strand, take twice the length and bend in half to make parallel strands. Fasten the loose ends in bench vise. Insert loop end in the chuck of hand drill. Pull slightly on the wire while cranking hand drill to keep wire taut. Don't let it kink. Anneal again before bending or retwisting because wire becomes brittle with working.

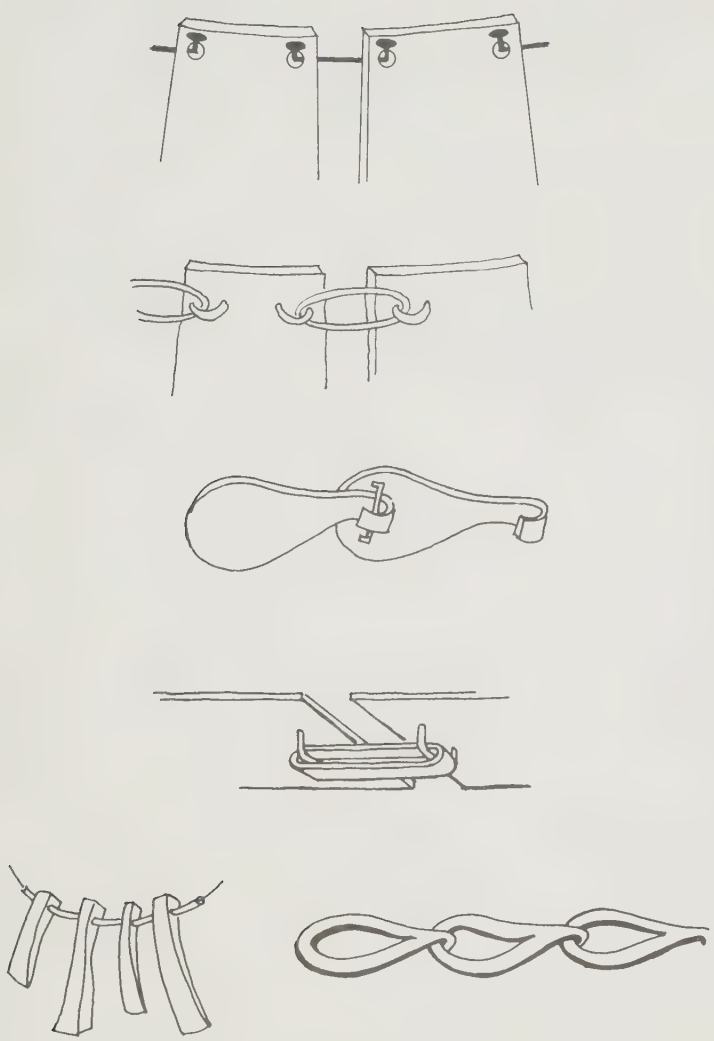


Fig. 53

JOINING DEVICES

Necklaces or bracelets made up of several similar solid or open units can be joined various ways, depending on the flexibility required and whether the linking device is to be visible or concealed. An extension of the unit itself can be bent through an opening of the next link. Fig. 53. If the hinge is to be concealed, overlap the units and put the tongue of each unit through a U shaped wire soldered under the next unit. Or U shaped wires can be soldered to each end under all units and joined by a link made of wire or sheet metal, depending on width of hinge.

For variety, fuse a ball on end of wire. Insert wire through holes in two units. Cut the wire a little longer than the link desired and fuse a ball. Bend to the shape desired.

To make a solid necklet, use about no. .050 round wire. If you have a draw plate, draw it down one size to add tension. Pass it through holes drilled in constructed or forged units. Space with tubing or beads to prevent overlapping.

FASTENINGS

Fig. 54 illustrates some easily constructed clasps. No specifications are given because you will have to vary the weight of metal to suit the project.

Try to develop a fastening that becomes a part of the design.

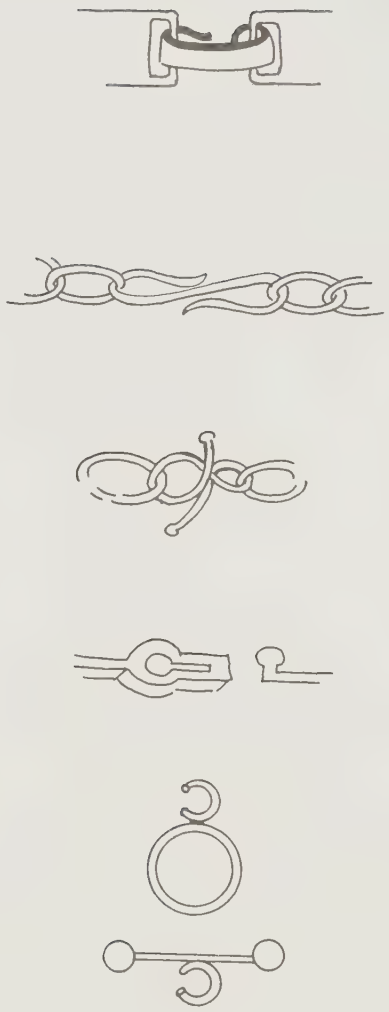


Fig. 54 easy to make clasps fastenings should be part of the design

Tools for a Group of 12 Students

6 jeweller's saw frames, 4" throat, adjustable
jeweller's saw blades, no. 2/0, no. 3/0

1 set needle files

4 hand files, 8", no. 0 for rough work

6 hand files, 6", no. 2 for finer work

2 half round files, 6", no. 2, slim

2 half round files, 6", no. 2

1 file card

jeweller's bench pins or V-board and clamp for each student

1 jeweller's shears, for cutting solder and fine wire

1 universal shears, for cutting metal

1 hand drill plus assortment of high speed twist drills

1 ring clamp
bench vises with smooth metal jaws. If jaws are serrated, slip on sleeves of lead or aluminium should be used

beeswax

centre punch

scribers

3 round nose pliers, 5"

3 flat nose pliers, 5"

2 half round pliers, 5" (one jaw flat, one half round)

1 chain nose pliers, 5"

2 chasing hammers, $1\frac{1}{2}$" head

4 ball pein hammers, 4 ounce. If heads are not polished, grind flat end to slightly rounded surface and round the ball. Bring both ends to a high polish with emery, tripoli and rouge

2 planishing hammers, $7\frac{1}{2}$ ounce

1 raising hammer, type as needed

1 cross pein hammer

1 ring mandrel, without groove

1 bezel mandrel

2 rawhide mallets, $1\frac{1}{2}$"

2 flat wooden mallets

2 round end wooden mallets

6 polished steel blocks

1 lead block

1 scraper, hollow

1 burnisher, straight

1 burnisher, curved

hardwood blocks

board for drilling

1 dividers, 6"

2 tweezers, cross locking for soldering

2 tweezers, pointed

1 scotch stone,

emery paper, no. 2, no. 2/0

1 tripoli, $\frac{1}{4}$ pound stick

1 red rouge, $\frac{1}{4}$ pound stick

1 $\frac{1}{4}$ hp motor with tapered spindle to hold buffs

2 4" muslin buffs

2 2" muslin buffs

or buffing sticks for hand polishing

2 Bernz-O-Matic torches

1 charcoal block

1 asbestos ring

carborundum grains, optional

small brushes for flux

binding wire, iron, medium weight

silver solder in strips, sheets or wire

Sparex no. 2, or sulphuric acid

acid container, fireproof glass or stoneware with cover

pickle tongs, brass or copper

liver of sulphur (potassium sulphide)

SUPPLIERS

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Very modern. Good illustrations but few practical explanations of techniques.

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Well illustrated. Contains good ideas but lacks instruction for many techniques.